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What Is a Thermite Reaction in Chemistry?

By Anne Marie Helmenstine, Ph.D.

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The thermite reaction is one of the more spectacular chemical reactions you can try. You're basically burning metal, except much more quickly than the usual rate of oxidation. It's an easy reaction to perform, with practical applications (e.g., welding). Don't be afraid to try it, but do use proper safety precautions since the reaction is highly exothermic and can be dangerous.

Iron Oxide and Aluminum Powder

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Thermite consists of aluminum powder together with a metal oxide, usually iron oxide. These reactants usually are mixed with a binder (e.g., dextrin) to keep them from separating, although you can mix the materials right before ignition without using a binder. Thermite is stable until it is heated to its ignition temperature, but avoid grinding the ingredients together. You will need:

50 g of finely powdered Fe_2O_3

15 g of aluminum powder

If you can't find aluminum powder, you can recover it from the inside of an Etch-a-Sketch. Otherwise, you can blend aluminum foil in a blender or spice mill. *Be careful!* Aluminum is toxic. Wear a mask and gloves to avoid inhaling the powder or getting it on your skin. Wash your clothes and any instruments that may have been exposed to the power. Aluminum powder is much more reactive than the solid metal you encounter every day.

Iron oxide as either rust or magnetite will work. If you live near a beach, you can get magnetite by running through the sand with a magnet. Another source of iron oxide is rust (e.g., from an iron skillet).

Once you have the mixture, all you need is a suitable source of heat to ignite it.

Perform the Thermite Reaction

CaesiumFluoride at English Wikipedia / Wikimedia Commons / CC BY 3.0

The thermite reaction has a high ignition temperature, so it takes some serious heat to initiate the reaction.

You can light the mixture with a propane or MAPP gas torch. While gas torches provide reliable, consistent heat, you need to use caution. Typically, you'll need to be very close to the reaction.

You can use a magnesium strip as a fuse.

You can light the mixture with a sparkler. While a sparkler is an inexpensive and readily available option, it doesn't supply a steady source of heat. If you use a sparkler, choose the "jumbo-sized" fireworks rather than the small, colored versions.

If you are using very finely powdered iron (III) oxide and aluminum, you can light the mixture with a lighter or book of matches. Use tongs to avoid getting a flash burn.

After the reaction has concluded, you can use tongs to pick up the molten metal. Do not pour water on the reaction or place the metal into water.

The exact chemical reaction involved in the thermite reaction depends on the metals that you used, but you're essentially oxidizing or burning metal.

The Thermite Reaction Chemical Reaction

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Although black or blue iron oxide (Fe_3O_4) is most often used as an oxidizing agent in the thermite reaction, red iron (III) oxide (Fe_2O_3), manganese oxide (MnO_2), chromium oxide (Cr_2O_3), or copper (II) oxide may be used. Aluminum is almost always the metal that is oxidized.

The typical chemical reaction is:

$Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3$ + heat and light

Note the reaction is both an example of combustion and also an oxidation-reduction reaction. While one metal is oxidized, the metal oxide is reduced. The rate of the reaction can be increased by adding another source of oxygen. For example, performing the thermite reaction on a bed of dry ice (solid carbon dioxide) results in a spectacular display!

Thermite Reaction Safety Notes

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The thermite reaction is highly exothermic. In addition to the risk of burns from getting too close to the reaction or having material ejected from it, there is a risk of eye damage from looking at the very bright light that is produced. Only perform the thermite reaction on a fire-safe surface. Wear protective clothing, stand far away from the reaction, and try to ignite it from a remote location.